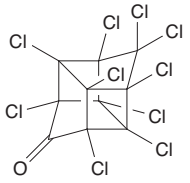
Kepone

CAS No. 143-50-0

Reasonably anticipated to be a human carcinogen

First listed in the *Second Annual Report on Carcinogens* (1981)

Kepone was formerly a registered trademark of the Allied Chemical Corporation; also known as chlordecone



Carcinogenicity

Kepone (chlordecone) is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

Dietary administration of chlordecone caused liver cancer (hepatocellular carcinoma) in rats and mice of both sexes. In addition, the time to detection of the first hepatocellular carcinoma observed at death was shorter in male mice exposed to chordecone than in unexposed controls and appeared to be inversely related to exposure level in mice and rats of both sexes (NCI 1976, IARC 1979).

Cancer Studies in Humans

The data available from epidemiological studies are inadequate to evaluate the relationship between human cancer and exposure specifically to chlordecone.

Properties

Chlordecone is a chlorinated polycyclic ketone that is an odorless, colorless-to-tan crystal at room temperature (HSDB 2009). It is practically insoluble in water, soluble in acetone, alcohols, ketones, and acetic acid, and less soluble in benzene and light petroleum. Chlordecone is stable to about 350°C but readily hydrates on exposure to humidity at room temperature (Akron 2009). Physical and chemical properties of chlordecone are listed in the following table.

Property	Information
Molecular weight	490.6[a]
Specific gravity	1.59 to 1.63 at 25°C[a]
Melting point	350°C (decomposes)[a]
Boiling point	434°C[b]
Log K_{ow}	5.41[a]
Water solubility	2.70 mg/L 25°C[a]
Vapor pressure	2.25×10^{-7} mm Hg at 25°C[a]
Vapor density relative to air	16.94[a]

Sources: [a]HSDB 2009, [b]Akron 2009.

Use

Chlordecone was first introduced as a pesticide in 1958 and was used until 1978, when its use in the United States was discontinued (NCI 1976, IARC 1979, HSDB 2009). Chlordecone was used as an insecticide for leaf-eating insects, ants, and cockroaches, as a larvicide for flies, and for control of insects that attack structures. Chlordecone was also used on bananas, non-bearing citrus trees, tobacco, ornamental shrubs, lawns, turf, and flowers.

Production

Total U.S. production of chlordecone from 1951 to 1975 was estimated at 3.6 million pounds (ATSDR 1995). Annual production at one plant in Hopewell, Virginia, reached a peak of over one million pounds per year in 1974; production ceased in July 1975 by order of the State of Virginia (Huggett and Bender 1980). Between 90% and 99% of total chlordecone production was exported to Europe, Asia, Latin America, and Africa (ATSDR 1995). In 2009, no producers of chlordecone were identified (SRI 2009), but chlordecone was available from eight U.S. suppliers and one European supplier (ChemSources 2009).

Exposure

The primary routes of potential human exposure to chlordecone are inhalation, ingestion, and dermal contact. Chlordecone is very stable in the environment, and no degradation products have been identified. It adsorbs to particulate matter in the air, water, and soil and is removed from the atmosphere and water column by deposition and settling and from the surface soil by erosion (ATSDR 1995). When released to air, chlordecone will not directly photodegrade or react with photochemically produced hydroxyl radicals (HSDB 2009). When released to water, chlordecone adsorbs to sediment and over time is buried by sediment accumulation (Huggett and Bender 1980). Its half-life in a model river is 3.8 to 46 years (HSDB 2009). Chlordecone bioaccumulates in fish and crustaceans (Carver and Griffith 1979). When released to soil, chlordecone will adsorb to soil particles; some leaching to groundwater may occur.

In the United States, detectable levels of chlordecone were found in 400 samples of air, drinking water, plant and aquatic organisms, and municipal waste where chlordecone was manufactured (ATSDR 1995). Chlordecone has also been measured in the particulate matter and sediment in rivers on the island of Martinique in 2002 at concentrations of up to 57 µg/kg (Bocquene and Franco 2005). Bananas are the major crop in Martinique, and chlordecone was frequently used as an insecticide on banana plantations.

Concentrations of chlordecone in the environment near the Hopewell manufacturing site were 1% to 40% in dust collected one block from the plant, 1% to 2% in soil adjacent to the plant, and 2 to 6 ppm in soil at a distance of 1,000 meters from the plant (Luellen *et al.* 2006). Very high concentrations of chlordecone were detected in effluent from the Hopewell plant (0.1 to 1.0 mg/L) and in water from the plant's holding ponds (2 to 3 mg/L). However, over time, concentrations in the James River (adjacent to the plant) have fallen dramatically due to settling of chlordecone and its eventual burial in sediment (Huggett and Bender 1980). Concentrations of chlordecone in bed sediments of the James River between 1976 and 1978 ranged from undetectable (≤ 0.01 µg/g) to 5 µg/g (ATSDR 1995). Chlordecone concentrations in finfish in the James River in the 1980s reached a steady state below the action level of 0.3 µg/g; however, 94% of the fish sampled since 1987 had detectable chlordecone concentrations (≥ 0.01 µg/g). Fishing restrictions remained in effect until 1989, when restrictions as a result of chlordecone contamination were removed; however, a Virginia Department of Health fish consumption advisory remained in effect as of 2006 (Luellen *et al.* 2006).

Chlordecone is also a degradation product of another insecticide, mirex (IARC 1979). Investigators have detected chlordecone in soil at a concentration of 0.02 µg/g of soil 12 years after mirex was applied at the rate of 1 µg/g of soil. Additional exposure information may be found in the Agency for Toxic Substances and Disease Registry's *Toxicological Profile for Mirex and Chlordecone* (ATSDR 1995).

At the time production ceased (in July 1975), half of the workers at the Hopewell manufacturing facility exhibited neurological

symptoms. Chlordecone was measured in the blood of these exposed workers at levels of up to 11.8 µg/mL. In 1976, the National Institute for Occupational Safety and Health identified 50 facilities that processed or formulated pesticides using chlordecone and estimated that about 600 U.S. workers potentially were exposed to chlordecone (NIOSH 1976).

Regulations

Environmental Protection Agency (EPA)

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable quantity (RQ) = 1 lb.

Resource Conservation and Recovery Act

Listed Hazardous Waste: Waste code for which the listing is based wholly or partly on the presence of chlordecone = U142.

Listed as a hazardous constituent of waste.

Food and Drug Administration (FDA)

Action levels for chlordecone in fish, shellfish, and crabmeat range from 0.3 to 0.4 ppm.

Guidelines

National Institute for Occupational Safety and Health (NIOSH)

Recommended exposure limit (REL) = 0.001 mg/m^3.

Listed as a potential occupational carcinogen.

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